Evaluation of hypoglycemic effect of lagerstroemia speciosa biology essay

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Original Research Article

EVALUATION OF HYPOGLYCEMIC EFFECT OF LAGERSTROEMIA SPECIOSA (BANABA) LEAF EXTRACT IN ALLOXAN INDUCED DIABETIC RABBITS

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ABSTRACT

Aims and Objectives: Lagerstroemia speciosa (Banaba) whose tea obtained from the leaves has long been used traditionally in the treatment of Diabetes mellitus in South Asian countries, especially the Philippines. In this study we investigated the effect of leaf extract of Lagerstroemia speciosa on fasting blood glucose levels at different doses in Alloxan induced diabetic rabbits. Materials and Methods: Diabetes mellitus was induced by a single intravenous injection of Alloxan monohydrate at a dose of 150mg/kg in rabbits. Banaba leaf extract was given orally once a day for 10 weeks. In three graded doses of 100, 400 and 800 mg/kg respectively. The results were compared with standard antidiabetic drug Metformin (62. 5mg/kg orally) Results: The elevated blood glucose levels in diabetic rabbits were significantly decreased by treatment with Banaba leaf extract at doses of 400 and 800mg/kg. The hypoglycemic effect of Banaba Leaf Extract at a dose 800mg/kg was comparable to Metformin (62. 5mg/kg). No significant

difference between Banaba Leaf Extract 800mg/kg and Metformin was observed. Conclusion: Based on these results, we suggest that Banaba leaf extract has favorable effects in protecting the Alloxan induced hyperglycemia. Keywords: Hyperglycemia, Alloxan monohydrate, Banaba leaf extract

INTRODUCTION

Type 2 diabetes develops into a worldwide epidemic. 1 Ironically, the dramatic increase in the prevalence of type 2 diabetes can be attributed to the rapid economic development and correlated to changes in lifestyle within the last 50 years. Type 2 diabetes is closely associated with obesity. Up to 90% of the patients with type 2 diabetes are either overweight or obese. 2 The readily available high calorie food and a sedentary lifestyle are major causes for obesity. Obesity contributes to insulin resistance and type 2 diabetes. Reducing obesity and stopping weight gain constitutes a way to slow down the rate of occurrence of type 2 diabetes. Most antidiabetic drugs are hypoglycemic or anti-hyperglycemia (blood glucose level reducing). However, most of these drugs are weight gain promoting i. e. adipogenic. Thus, these drugs treat one of the key symptoms of type 2 diabetes, hyperglycemia, but exacerbate the condition of being overweight or obese, one of the leading causes of type 2 diabetes. Therefore, while these drugs are beneficial over the short term, they are not optimal for long term health of type 2 diabetic patients. The most desirable situation would be the development of new types of antidiabetic drugs that are either hypoglycemic or antihyperglycemic without the side effect of promoting

weight gain (adiposity). Herbal medicines known to be useful in diabetes treatment may be able to lead to compounds with such a combination of ideal therapeutic properties. 3One such plant Lagerstroemia speciosa (Banaba) whose tea obtained from the leaves has long been used traditionally in the treatment of Diabetes mellitus in South Asian countries, especially Philippines were selected for the study. 4Lagerstroemia speciosa which is commonly called as Banaba, crape myrtle in Philippines belongs to the family Lythraecae. In India it grows widely in Maharashtra and commonly called as Queen’s flower and Pride of India. It is a deciduous tropical flowering tree, 5 to 7 m high, sometimes growing to a height of 20 meters. Leaves are large, spatulate, 2-4 inches in width, 5-8 inches in length. It sheds leaves in the first months of the year. Before shedding, the leaves are bright orange or red during which time it is thought to contain higher levels of corosolic acid, the active principle considered. Flowers are racemes, pink to lavender, flowering from March to June. After flowering, the tree bears large clumps of oval nut like fruits. 5, 6The present study aims to evaluate the anti diabetic potential of the leaf extract of Lagerstroemia speciosa (Banaba) on laboratory animal model rabbit and its potency compared with a known standard antidiabetic drug Metformin with 3 different doses of the extract.

MATERIALS AND METHODS

Banaba Leaf Extract (BLE): The leaf extract of Lagerstroemia speciosa (Banaba) was obtained from Indfrag Ltd. The extract was prepared by water extraction method. The extract was standardized to 1% corosolic acid, the active principle. The extract was stored in cool and dry climate. Accurately

weighed quantity of Banaba leaf extracts suspended in distilled water was administered to rabbits orally using a feeding tube. Drugs and Chemicals: Metformin pure powder (Franco Indian Pharmaceuticals) was used as a Standard drug. Metformin was suspended in distilled water and administered to rabbit orally via oral feeding tube. Animals: New Zealand white rabbits (2. 5- 4kg) were used for the study. They were housed in an air-cooled central animal house. The animals were acclimatized to laboratory conditions (12: 12h dark/light, 25o 2o C) for a period of 7 days. They had free access to food and water ad libitum. The experimental protocol was approved by the Institutional Animal Ethics Committee of Kamineni Institute of Medical Sciences, Narketpally. All animals were handled according to CPCSEA guidelines, Govt. Of India. All the experiments were conducted between 0900 h to 1800 h. Induction of Diabetes mellitus7, 8: Diabetes mellitus was induced in the rabbits with normal blood glucose levels by a single injection of Alloxan monohydrate 150mg/kg body weight I. V. Through an ear marginal vein.(5% w/v in citrate buffer at a pH of 3. 5- 4) After 2 hrs of Alloxan injection, Dextrose 10% were fed to all rabbits to prevent hypoglycemia. After 72 hrs, blood glucose of all rabbits was estimated. Rabbits with fasting blood glucose levels of 220-500mg/dl were considered as diabetic and selected for further study and blood glucose levels were estimated daily for 7 days and then weekly for 10 weeks.

Treatment Schedule

All the rabbits that were successfully induced were randomly allocated into five groups of 6 animals each and treated once daily for 10 weeks as follows:

Group 1 received vehicle (distilled water) 2ml. Groups 2, 3, 4, received Banaba leaf extract. (In the graded doses of 100, 400 and 800 mg/kg). Group 5 received Metformin (62. 5mg/kg, orally) respectively. 9

Estimation of Blood Glucose10

The hypoglycemic effect of Banaba leaf extract was evaluated by estimating blood glucose levels from pre-standardized Glucometer with reagent strips by the glucose oxidase method. Fasting Blood Glucose levels were estimated daily in the first week after induction of diabetes and then once a week for 10 weeks.

Statistical analysis11

All data analysis was completed using SPSS software. Data are expressed as mean ±SEM. One way analysis of variance (ANOVA) followed by Least significant difference (LSD) test for post-hoc analysis was used. P values less than 0. 05 was considered statistically significant.

RESULTS

Changes in blood sugar, Administration of Alloxan monohydrate (150mg/kg IV) produced hyperglycemia within 72 hours and it was maintained up to 10 weeks in placebo group fed with distilled water. Pre treatment with BLE reduced the hyperglycemic effect of Alloxan in a dose dependent manner. BLE at a dose of 100mg/kg did show a significant reduction in blood glucose levels but only at the end of 8th week. BLE at a dose of 400mg/kg showed statistically significant reduction in comparison to placebo treated group at the end of 6 weeks, whereas BLE at a dose of 800mg/kg and Metformin

caused significant reduction in blood glucose levels as early as 2nd week. The reduction of blood glucose level was evident from the 2nd week with BLE at a dose of 800mg/kg and the values reached near normal by 8 - 10 weeks. The hypoglycemic effect of BLE 800mg/kg is comparable to Metformin (62. 5mg/kg) as there is no statistical significance between these groups at any point of time.

Table 1: Mean Fasting blood glucose level in Alloxan induced diabetic rats

GroupDay 12nd week4th week6th week8th week10th weekGroup I340. 6 ± 27. 8329. 0 ± 27. 5323. 0 ± 23. 4308. 4 ± 16. 6303. 0 ± 24. 8295. 4 ± 20. 3Group II339. 4 ± 28. 8305. 0 ± 28. 34286. 0 ± 69. 0274. 0 ± 32. 0257. 0* ± 28. 7238. 2* ± 28. 2Group III335. 4 ± 21. 1295. 4 ± 24. 68253. 6 ± 20. 98195. 20* ± 19. 2164. 8** ± 14. 4129. 2** ± 7. 6Group IV323. 0 ± 15. 1244. 8* ± 26. 1186. 6* ± 23. 1149. 6** ± 12. 4112. 0** ± 5. 398. 0** ± 5. 4Group V305. 4 ± 23. 7230. 0* ± 15. 3179. 4* ± 7. 0124. 0** ± 7. 3111. 4** ± 2. 593. 4** ± 3. 6BLE – Banaba Leaf Extract, data represented as Mean±SEM, *P < 0. 05 as compared to placebo, **P <0. 01(Significant), ***P <0. 0001(Highly significant)

Fig. 1: Comparison of Mean Fasting blood glucose levels in between groups

DISCUSSION

The existing drugs which are used today in the treatment of Diabetes address one of the key symptoms of type 2 diabetes, i. e. hyperglycemia but on the other hand promote weight gain. Further due to various reported side

effects of currently used anti diabetic drugs, there exists a need for their substitution with natural products which have a hypoglycemic effect and fewer side effects. A considerably large number of plants and herbs are known for their antidiabetic effects through folklore but their introduction into modern therapy can only be done after pharmacological testing by modern methods. Among several plants, the strongest candidate was Banaba with Corosolic acid as active ingredient. We therefore have chosen to study the effect of Banaba Leaf Extract on blood glucose levels in Alloxan induced Diabetic rabbits. Although Lagerstroemia speciosa has been shown to produce hypoglycemic effects in some mouse models of diabetes, there are no reports on the effects of this substance in alloxan-induced diabetic rabbits. Thus, the present study aimed to elucidate the hypoglycemic effects of L. Specials in Newzealand white rabbits. The anti-hyperglycemic effect of Banaba in genetically engineered diabetic mouse model was reported by Kakuda et al. 12 and in alloxan induced diabetic mouse model by N. C. Tanquilut1etal. 13 Further studies are required in other animal species to establish the hypoglycemic effect of Banaba and also as a prerequisite for conducting clinical studies. Alloxan induced diabetes mellitus is a well established model and shares many features with human Diabetes mellitus. Alloxan as a cytotoxic agent to the insulin-secreting β cells of the pancreas effectively induces Diabetes mellitus in a wide variety of animal models. Alloxan is capable of inducing both Type I and Type II diabetes with proper dosage selection and makes easy to put to use the experimental animals within 3 days after induction of diabetes mellitus and can be maintained to prevent death throughout the experimental period. On the other hand

surgical and genetic methods require high technical skills and may be associated with a high percentage of animal death and thus rarely used. 7, 8. In the present study, hyperglycemia induced by Alloxan was maintained up to 10 weeks in the Placebo group. Significant reduction of blood glucose levels in alloxan-induced diabetic rabbits treated was observed only at the end of 8 weeks at a dose of BLE 100 mg/kg. BLE at a dose of 400mg/kg showed statistically significant reduction in comparison to placebo treated group at the end of 6 weeks, whereas BLE at a dose of 800mg/kg and Metformin caused significant reduction in blood glucose levels as early as 2nd week. Further, blood glucose levels reduced to near normal levels with BLE 800mg/Kg. The hypoglycemic effect of BLE 800mg/kg is comparable to Metformin (62. 5mg/kg) as there is no statistical significance between these groups. Banaba had been reported to produce the anti hyperglycaemic effect with multiple mechanisms. The leaf decoction was used by native Philippines in the management of Diabetes mellitus. The first report on the hypoglycemic activity of Banaba leaf decoction was given by Garcia F et al. In 19th century itself14. Guy Klein et al. Reported antiobesity and hyperlipidemias activity with Lagerstroemia speciosa15. Studies have shown that biologically active substances obtained from Banaba leaf include Corosolic acid, Ellagitannins, Lagerstroemin, Flosin B and Reginin A which activate glucose uptake when studied in rat adipose cells, the physiological target cells of insulin16. The compound widely studied and accepted as the most potent active principle is Corosolic acid. Corosolic acid induces GLUT4 translocation onto plasma membrane. Binding of insulin to receptors on muscle cells leads rapidly to fusion of those vesicles with the plasma

membrane and insertion of the glucose transporters (GLUT4), thereby giving the cell an ability to efficiently take up glucose17, 18. Similarly, Corosolic acid makes the induction of GLUT4 translocation and uptake of glucose into the cells, lowering glucose levels in the blood. Furthermore Corosolic acid stimulates glucose uptake via enhancing insulin receptor phosphorylation. Corosolic acid also exhibits antioxidant effect 19, 20 and anti diabetic activity as like as vitamin E, which can protect cell membranes from lipid peroxidation by scavenging free radicals. It also acts as alpha-glucosidase inhibitors, slowing down the absorption of starchy foods from the intestine, thereby retarding the rise in blood glucose after meals. Other beneficial effects reported with the use of Banaba leaf extract includes anti obesity action and decrease in the levels of cholesterol. 21, 22

CONCLUSION

Banaba leaf extract is having hypoglycemic activity and can be effectively used in the management of diabetes mellitus. With the functions and mechanisms discussed, Banaba could be the best natural anti diabetic remedy for prevention and treatment of Diabetes mellitus as a natural gift without any other side-effects shown in current prescribed anti diabetic drugs.